

Both silica-rich and silica-poor types occur, as at Albury (Joplin, 1947), the latter being characterized by spinel. Cordierite, sillimanite, spinel and almandine garnet are characteristic minerals of the pelitic xenoliths.

Cordierite forms large plates intergrown in places with sericitized plagioclase. Usually the cordierite itself is highly pinitized, alteration having taken place along cracks and cleavages. Zircon inclusions with distinctive yellow pleochroic haloes are seen both in fresh and altered cordierite. When occurring with quartz, cordierite is xenoblastic towards it, and sericite-filled cracks in the cordierite radiate outwards from the boundaries with the quartz grains. Most of the cordierite is biaxial negative, but a single case of positive cordierite has been observed.

TABLE 2.

Chief Minerals.	Associated Minerals.
(1) <i>Pelites.</i>	
(a) <i>Silica-poor.</i>	
cordierite, sillimanite, spinel.	plagioclase, (clinozoisite).
cordierite, spinel.	plagioclase, (orthoclase, quartz).
sillimanite, spinel.	
(b) <i>Silica-rich.</i>	
cordierite, sillimanite.	plagioclase, (biotite, orthoclase, quartz).
cordierite, orthoclase.	biotite, quartz.
cordierite, plagioclase.	biotite, quartz.
cordierite, garnet.	biotite, (plagioclase).
cordierite, garnet, sillimanite.	quartz, biotite.
garnet, hypersthene.	biotite.
garnet, hypersthene, cordierite.	biotite, (quartz).
hypersthene, plagioclase, orthoclase.	biotite, quartz.
(2) <i>Psammites and Psammopelites.</i>	
quartz, andesine.	
quartz, andesine, biotite.	(hypersthene or diopside).
quartz, sodic plagioclase, orthoclase.	(epidote).
(3) <i>Notably Calcareous Xenoliths.</i>	
clinozoisite, plagioclase, quartz.	(orthoclase).
clinozoisite, quartz.	(tremolite).
quartz, epidote, actinolite.	
(4) <i>Xenoliths of Igneous Origin.</i>	
hypersthene, plagioclase, magnetite.	quartz, biotite (in reaction-rim).
hypersthene, plagioclase, biotite.	
plagioclase, quartz, biotite.	orthoclase, ilmenite, epidote, etc.
(5) <i>Granitized Xenoliths.</i>	
plagioclase, quartz, biotite.	orthoclase.

Sillimanite usually occurs as groups of needles in cordierite or garnet, but sometimes it forms a large proportion of the xenolith, in swirling masses which follow the plications of the original pelite. It suffers sericitization with advancing reaction with the magma.

Spinel, sometimes associated with magnetite, occurs in groups of dark green to black crystals and grains which vary in degree of perfection of form. It is probably rich in the hercynite molecule, and is most abundant in those areas of the xenoliths which are biotite-poor and rich in cordierite and sillimanite.

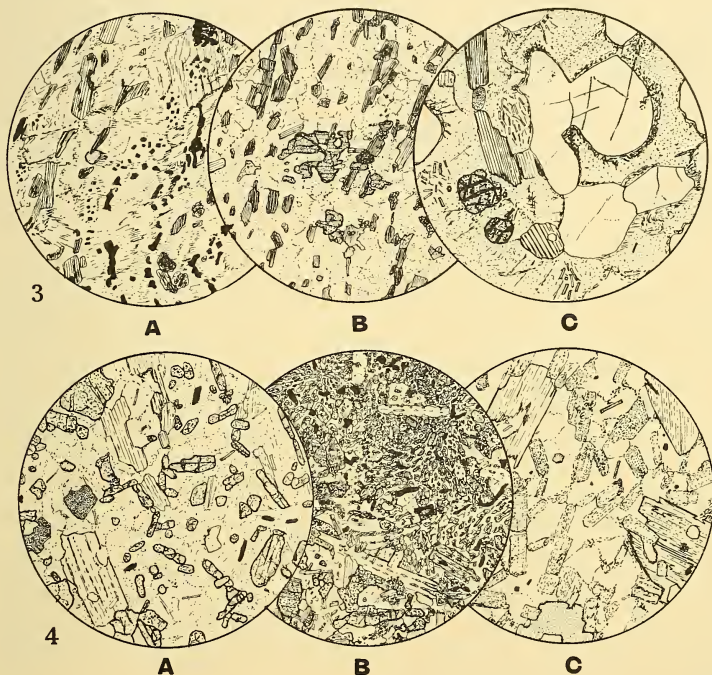
Pale pink subidioblastic rounded garnets up to 1.5 cm. in diameter are often present in the silica-rich pelites, generally associated with the biotite. In places garnet is present as angular fragments in a mass of sericitic material, which may have resulted from original cordierite. Cracks in the garnet are sometimes filled with bright green chlorite, sericite or a little quartz, but on the whole it is not greatly altered and seems moderately stable.

Garnet from Matheson Trig. Station has a R.I. of $1.805 \pm .005$, the S.G. is 4.12 and the percentage of MnO is 2.06. These figures are close to those obtained for garnet from silica-rich pelitic xenoliths at Albury (Joplin, 1947), and indicate an almandine with minor percentages of pyrope (20%) and spessartine (5%).

Another interesting association is that of garnet with hypersthene, the latter as subidioblastic inclusions in garnet as well as an outer reaction-rim, beyond the zones

of magnetite and biotite. The hypersthene is pale green, with intense pleochroism from grey-green to beige, and is probably rich in iron.

Hypersthene occurs in quite a different manner in the quartz-biotite-plagioclase-hypersthene hornfelses. Here, garnet is absent and the pyroxene is in occasional xenoblasts of smaller grainsize.



Text-fig. 3.

A. Pelitic xenolith containing cordierite, plagioclase, spinel (black) and biotite, showing biotite-rich and spinel-rich bands.

B. A biotite-plagioclase xenolith with occasional hypersthene.

C. A cordierite-rich xenolith, with quartz (clear), biotite, garnet and sillimanite (small needles).

(Magnification \times sixteen.)

Text-fig. 4.

Xenoliths of probable igneous origin.

A. A hypersthene-plagioclase-biotite assemblage.

B. Hypersthene-biotite-magnetite xenolith.

C. Plagioclase-quartz-biotite xenolith with some chlorite and apatite.

(Magnification \times sixteen.)

Biotite is the most abundant mineral in many of the pelitic xenoliths, whose original bedding may be delineated by biotite-rich bands. Zircon inclusions and sagenite webs are notable, also alteration to epidote. In some mottled pelites, cordierite forms a diablastic intergrowth with biotite (Plate vii, fig. 8), giving a rude micrographic fabric.

Plagioclase varies in grainsize and degree of alteration, but its composition is mainly andesine, Ab_{52} to Ab_{60} , roughly equivalent to the plagioclase in the granodiorite.

Although plagioclase of such a composition would crystallize from the granodiorite (as a result of the Reaction Principle), it seems likely that some plagioclase was an original constituent of the xenoliths.

Clinzoisite is present in the calcareous pelites, and occurs in subidioblastic crystals associated with quartz and plagioclase. This association rapidly grades into one in which hypersthene takes the place of clinzoisite. Clinzoisite or epidote, in strings of granules, occurs in some of the silica-poor pelites. Its occurrence here is rather unexpected, and its presence may be due to extremely thin calcareous bands in the original sediment (cf. Tilley, 1924, p. 40). Sediments exhibiting such a degree of metamorphism could well be expected to have all the clinzoisite converted to calcic plagioclase (Harker, 1932).

Other minerals in the pelitic xenoliths which make an occasional appearance are sphene and blue-grey tourmaline. The latter may be derived from recrystallization of tourmaline in the original sediment, as no tourmaline has been found elsewhere in the Cowra Intrusion.

(2) Psammites and Psammopelites.

Psammitic xenoliths are of much rarer occurrence than pelitic. They are fine to medium-grained banded granulites with quartz, feldspar and biotite. Some hypersthene-bearing types are found, and these grade into the quartz-feldspar-hypersthene assemblages of the pelitic xenoliths, marking the gradation in the original sediment from pelite through psammopelite to psammite.

Diopside has been detected in one of these xenoliths, showing alteration to a fibrous green amphibole. Epidote, muscovite, apatite and zircon may also be present. Plagioclase shows more variation in composition than in the pelites, ranging from albite-oligoclase to andesine.

(3) Calcareous Xenoliths.

These are characterized by the minerals clinzoisite and epidote, and they are accordingly yellowish-green in hand specimen. The grain size is fine and most of the minerals are xenoblastic. Some xenoliths are made up mostly of quartz and clinzoisite, with accessory tremolite, and others (richer in iron) consist of quartz and yellow-green epidote, with a little actinolite. Reaction-zones of such xenoliths consist of biotite, quartz, plagioclase and hypersthene. It is possible that some of the quartz-feldspar-hypersthene assemblages previously noted may have been calcareous types which have suffered much reaction with the magma.

(4) Xenoliths of Igneous Origin.

Very few of the xenoliths are of definite igneous origin. A former basalt or dolerite is represented by a hypersthene-plagioclase-magnetite rock with blastophitic fabric. A reaction-rim, one-fifth of the diameter of the xenolith, consists of biotite, quartz and plagioclase.

A plagioclase-hypersthene-quartz-biotite xenolith, similar in mineralogical composition to some derived from pelites, differs from them in its texture and complete lack of evidence of former bedding. Occasional large plagioclases are intergrown with quartz, and the hypersthene in these xenoliths is notable for its strong pleochroism. The chemical analysis (Table 3) corresponds to that of an igneous rock, e.g., an andesite.

(5) Granitized Xenoliths (quartz-feldspar-biotite assemblages).

There are numerous xenoliths containing the same minerals as the granodiorite, but showing no signs of bedding. They are of slightly finer grain size than the granodiorite and more melanocratic. At Cowra, a few transition types between sedimentary xenoliths and "igneous-looking" xenoliths have been found.

ORIGIN OF THE XENOLITHS.

(a) Sedimentary Xenoliths other than those of the Silica-Poor Group (1a, 2 and 3 above).

As the Silurian wall-rocks are not greatly affected by the intrusion, and all xenoliths (even near the margin of the intrusion) have suffered fairly high-grade metamorphism, it is likely that the sedimentary ones have been derived from Ordovician or older sediments occurring at depth, and have been carried upward by the magma, i.e., they are hypoxenoliths (Goodspeed, 1948).

The mineral assemblages of the pelitic xenoliths indicate an abundance of iron oxides, magnesia and alumina. It is not certain, however, that the original sediment was abnormally high in these oxides, for we do not know to what extent chemical change has affected the composition. Garnet in the pelitic xenoliths probably occurred in the country rock before it was enclosed in the magma, and may have been a constituent of pre-existing regionally metamorphosed schists. When isolated from the xenoliths by mechanical disintegration, it is found in the granodiorite encased in a reaction rim of biotite and, less commonly, hypersthene and magnetite (Plate vii, fig. 4). The pelitic xenoliths of Cowra differ from those of Albury mainly in the amount of plagioclase in the former, indicating that the original pelites at Cowra were richer in soda and lime.

TABLE 3.

	1	2	
SiO ₂ ..	59.44	59.20	
Al ₂ O ₃ ..	14.27	15.98	
Fe ₂ O ₃ ..	0.45	3.30	
FeO ..	8.48	3.69	
MgO ..	4.84	3.10	
CaO ..	5.61	7.02	1. Hypersthene - plagioclase - biotite - quartz
Na ₂ O ..	3.47	3.31	xenolith. The Beacon, Cowra. Anal. N. C.
K ₂ O ..	0.95	1.26	Stevens.
TiO ₂ ..	1.35	0.55	2. Hypersthene andesite. Blair Duguid, N.S.W.
P ₂ O ₅ ..	pncl.	0.17	Anal. H. P. White, W. R. Browne and
MnO ..	0.10	0.30	H. P. White, <i>J. Proc. Roy. Soc. N.S.W.</i> , 60
H ₂ O + ..	0.75	1.13	(1926): 372.
H ₂ O - ..	0.22	0.73	
Etc. ..	—	0.48	
	99.93	100.22	
S.G. ..	2.86	2.74	

The psammites and psammopelites also show the same tendency, as shown by the presence of intermediate plagioclase and occasional diopside, epidote and clinozoisite. The calcareous xenoliths, with their high proportion of quartz, appear to have been calcareous sandstones or tuffs.

(b) Igneous Xenoliths.

The few igneous xenoliths that have been found seem to have been derived from basalts and andesites (Table 3), probably of Ordovician age, similar to types outcropping a few miles north-east of Cowra.

(c) Granitized Xenoliths (5, above).

It is considered from the general features of texture and constitution that these types could be either (a) cognate xenoliths or (b) sedimentary xenoliths showing a high degree of reaction with the magma, i.e., granitization. Grout (1937) cites much evidence to show that sedimentary xenoliths can be converted to "igneous-looking" rocks having the same minerals as the enclosing rock and thus being in complete equilibrium with the surrounding magma. The texture may be finer-grained, with the occurrence of "phenocrysts". In view of the transition between sedimentary and igneous-looking xenoliths (mentioned above) it is possible that the more siliceous pelites gave

rise to the quartz-felspar-biotite assemblage (after granitizing reaction), while the pelites with 50%-60% silica were the source of the silica-poor xenoliths (see next paragraph).

(d) Silica-poor Xenoliths (1a).

The silica-poor xenoliths, represented by those containing spinel in association with cordierite or sillimanite or both, are very similar to those described by Joplin (1947) from gneiss contaminated by Ordovician sediments at Albury, N.S.W. The occurrence of spinel-bearing xenoliths in a rock with nearly 67% SiO₂ is unusual, especially when

TABLE 4.

	1	2	3	4	5	6	7	8
SiO ₂	43.11	44.52	45.30	42.08	40.16	62.23	70.17	69.98
Al ₂ O ₃	32.61	28.63	30.51	32.40	29.50	12.20	13.00	12.74
Fe ₂ O ₃	0.68	1.78	0.24	13.44	19.66	6.49	5.22	6.25
FeO	7.51	10.75	8.80		5.80	0.84	1.26	
MgO	3.93	4.14	3.11	3.30	tr.	3.07	1.83	4.19
CaO	2.90	1.25	0.90	1.42	0.85	3.23	0.32	0.76
Na ₂ O	0.77	3.21	1.65	1.60	1.46	3.21	1.15	pnd.
K ₂ O	6.01	2.69	4.84	2.20	1.36	2.48	3.17	pnd.
TiO ₂	2.06	2.05	1.48	2.16	—	1.30	0.97	0.82
P ₂ O ₅	pnd.	0.03	0.12	—	—	pnd.	0.14	pnd.
MnO	0.10	tr.	0.20	—	—	0.14	0.06	0.23
H ₂ O +	0.62	0.45	1.05	1.60	—	3.34	2.47	—
H ₂ O -	0.25	0.20	0.26		—	—	2.07	0.96
S	—	0.27	1.32*	—	0.82	—	—	—
SO ₃	—	tr.	0.04	—	—	—	—	—
Etc.	—	—	0.30	—	—	—	—	—
	100.55	99.97	100.12	100.20	99.61	100.60	100.72	—
S.G.	2.89	—	2.835	—	—	2.54	2.62	2.69

* 0.36% FeS₂ and 0.96% FeS₃.

1. Cordierite-sillimanite-spinel xenolith. $\frac{1}{2}$ mile N. of Cowra Post Office. Anal. N. C. Stevens.
 2. Cordierite-spinel hornfels, at contact with diorite. Craig More, Comrie, Scotland. Anal. C. E. Tilley. *Quart. J. Geol. Soc. Lond.*, 80, 1924: 22.
 3. Corundum-cordierite-spinel hornfels. Ascunty Mtn., Vermont. Anal. W. F. Hillebrand. R. A. Daly, *U.S. Geol. Surv. Bull.*, 209, 1903: 29.
 4. Cordierite-hornfels. N. end of Black Hill, Aberdeenshire. Anal. J. J. H. Teall, *Geol. Surv. Gr. Brit.* (Braemar), 1912: 16.
 5. Manhattan Schist, on contact of Cortlandt Series. Anal. F. L. Nason. G. H. Williams, *Amer. J. Sci.*, 36, 1888: 259.
 6. Slate (buff-coloured, somewhat weathered). Cowra Brickworks Quarry.
 7. Slate (buff-coloured). Mining Reserve, Burdett; N.N.W. of Canowindra.
 8. Phyllitic slate (greenish-coloured). Cowra Brickworks Quarry.
- Analyses 6, 7 and 8 by N. C. Stevens.

there is an apparent lack of silica-poor sediments among the country rocks. The acidity of the Cowra Granodiorite is comparable with that of the Albury Gneiss, and it is to be noted that no silica-poor sediments have been found near Cowra. Analyses of slates from the Cowra district (Table 4) show that they are even more siliceous than the normal pelites at Albury.

Dr. Joplin suggests that the silica-poor xenoliths were derived from chlorite-rich bands or knots, the latter being formed by segregation during contact metamorphism. Xenoliths derived from these knots would be limited in size, and would not show bedding. At Albury, iron oxides, alumina and magnesia are higher in an analysed silica-poor xenolith than in the average normal pelite (and silica is lower). According to Dr. Joplin, "storing up of these constituents within the xenolith . . . may be accounted for by assuming that certain minerals lower in the reaction series than those being

precipitated by the magma were dissolved out, thereby enriching the xenolith in phases higher in the reaction series".

These ideas are similar to those expressed by Tattam (1925), when dealing with silica-poor xenoliths in the granodiorite of Bulla, Victoria. Quartz is melted out of quartz-chlorite-sericite xenoliths and plagioclase crystallizes within them, so that they are desilicated, with the formation of sillimanite and spinel.

It is difficult to imagine these processes taking place without complete disintegration of the xenolith, and if such a disruption did not occur, why should the quartz have shown such a marked tendency to leave the xenolith and enter the magma?

An analysis of a typical silica-poor xenolith from Cowra is compared in Table 4 with rocks of similar composition and with some Silurian slates.

Such changes have been illustrated by Daly (1903), who described a progression in contact metamorphism in the same lithologic unit at Ascutey Mtn., Vermont. Variation from phyllite to corundum-cordierite-spinel hornfels occurred as the contact with an intermediate plutonic rock was approached.

Reynolds (1946) has shown that pelitic rocks undergo changes in two stages, first desilication then granitization; also that during desilication there is commonly an introduction of Fe, Mg, Ca and one or more of TiO_2 , P_2O_5 and MnO. Iron and magnesia are regarded as constituents driven from country rocks which have been granitized; however, the abnormal alumina percentages noted above remain unexplained. Read (1951) gets closer to this problem by suggesting that in certain cases "NaSi has been extracted with consequent piling up of $AlFeMg$ " and that some occurrences of highly aluminous rock might be due to subtractions connected with metamorphic differentiation.

Acknowledgements.

The writer wishes to thank Dr. W. R. Browne and Dr. G. D. Osborne for their advice in the preparation of this paper, and Professor C. E. Marshall for laboratory facilities in the Geology Department of the University of Sydney.

Most of the work was carried out during the tenure of a Linnean Macleay Fellowship.

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EXPLANATION OF PLATE VII.

1. Cowra Granodiorite ($\times 30$).
2. Granodiorite porphyry (crossed nicols, $\times 30$).
3. Cordierite-sillimanite-spinel xenolith ($\times 50$).
4. Magnetite and hypersthene at the margin of a garnet xenocryst in the granodiorite ($\times 60$).
5. Clinzoisite-quartz xenolith ($\times 50$).
6. Sillimanite-spinel xenolith ($\times 50$).
7. Spinel bordering sillimanite in a xenolith ($\times 60$).
8. Intergrowth of biotite and cordierite in a mottled pelitic xenolith ($\times 30$).

Photomicrographs by G. E. McInnes and N. C. Stevens.

ROPY SMUT OF LIVERPOOL PLAINS GRASS.

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(Plate viii; one Text-figure.)

[Read 30th July, 1952.]

Synopsis.

A smut attacking Liverpool Plains Grass (*Stipa aristiglumis* F. Muell.) is described from the north-western slopes of New South Wales. Another grass (*Stipa* sp. (?)) was also found attacked. The spore balls of the fungus develop in, and ultimately replace, the parenchyma of the stem, so that when the balls are released at maturity, the separated vascular bundles give the stem a ropy appearance.

Germination of the smut was obtained in water, sporidia were produced on dextrose agar medium, and the fungus was obtained in pure culture. The nuclear condition of the promycellum and sporidia was determined. The name *Tolyposporium restifaciens* is proposed for the fungus.

In 1950 diseased specimens of Liverpool Plains Grass (*Stipa aristiglumis* F. Muell.) were collected in the Piallaway area of the north-western slopes of New South Wales. The causal organism did not appear to conform to any previously described on species of *Stipa* or on any other grass. The disease was tentatively described as "Ropy Smut". Further collections of diseased material have since been made throughout the area, as follows:

TABLE I.

S.U. Acc. No.	Date Collected.	Collector.	Locality.	Host.
241	28. 8.50	D. Shaw and A. L. Dyce.	Piallaway.	<i>S. aristiglumis</i> .
534	10. 7.51	D. Shaw.	Breeza Plains.	<i>S. aristiglumis</i> .
535	10. 7.51	D. Shaw.	Piallaway.	<i>Stipa</i> sp. (?).
681	23.10.51	P. G. Valder.	Gunnedah.	<i>S. aristiglumis</i> .
693	10.12.51	G. Dickson.	Breeza Plains.	<i>S. aristiglumis</i> .

Stipa aristiglumis is a native perennial grass, and on the north-western slopes forms large tussocks usually about six feet in height. The grass collected as S.U. Accession No. 535 consisted of diseased stems and some unaffected heads, with, however, only the glumes remaining. The clumps of this grass were about 1-1½ feet high, in an area where *S. aristiglumis* was about five feet high. The specimen was thought to be a small species of *Stipa*, but after examination Miss Vickery of the Botanic Gardens stated that even the generic identification was uncertain. It was not, however, *S. aristiglumis*.

SYMPTOMS.

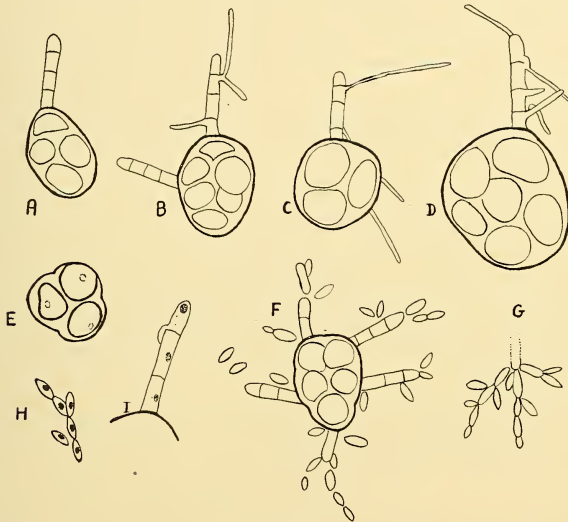
Macroscopically, the disease is not obvious as a smut. Diseased stems resemble lengths of teased-out, twisted rope. In the specimens of *S. aristiglumis* only the upper internode had the ropy appearance (Plate viii, A). Several internodes of the grass stems of S.U. Accession 535, however, were diseased, with the vascular bundles held together at the nodes.

The disease could not at first be easily detected in the green stems as no "teasing-out" appeared at this stage.

THE CAUSAL ORGANISM AND LOCATION IN THE HOST.

The spore balls of the fungus are dusty at maturity and brown (Sandford's Brown; Ridgway, 1912) to the naked eye. In most cases the balls are slightly longer than broad, and from *S. aristiglumis* measure $18-28 \times 20-38 \mu$, being composed of 5-15 spores permanently united. Balls from S.U. Acc. 535 measure $18-40 \times 26-40 \mu$, composed of 7-26 spores permanently united. The spores are yellowish (Raw Sienna; Ridgway, 1912) in reflected light, and $8-10 \mu$ in diameter. They are subglobose to slightly angular, with adjacent and free sides smooth.

Transverse sections were made through diseased stems of *S. aristiglumis* of the current season's growth, in order to trace the extent of the fungus and its location in the host tissues. At a position one inch from the tip most of the spore balls were pigmented, and some remained unstained with cotton-blue lacto-phenol. The average



Text-fig. 1.

A-D, Germination of *T. vestificiens* in water, showing strongly septate promycelia with thin lateral and terminal branches. E, Surface view of small spore ball with one germ pore per spore. F, Germination on P.D.A. after presoaking in water, showing production of abundant promycelia and sporidia (slightly displaced during staining). G, Budding sporidia on P.D.A. H, Budding sporidia from culture with one nucleus per cell. Stained with Giemsa. I, Promycelium with one nucleus per cell. Stained with Giemsa. Camera lucida drawings, $\times 700$.

width of the spore balls was 19μ . Nearly all the parenchymatous tissue between the bundles was replaced by the spore balls, but the epidermis was still intact. A section through this region is shown in Plate viii, B.

Sections taken at various intervals down the stem revealed that, as the distance from the tip increased the spore balls became less pigmented, smaller in size, contained fewer spores, and were not nearly so numerous as at the tip. In sections 12 inches from the tip and four inches above the uppermost node, the average width of the spore balls was 14μ , and many of the balls consisted of a few spores only. Many parenchyma cells were still identifiable as such, with distorted cells surrounding developing spore balls. The balls were more widely scattered throughout the parenchyma, with the concentration heaviest at the centre. No spore balls at all could be detected in the area 1-2 inches above the uppermost node or in the lower

internodes. In S.U. Acc. 535, however, development of the organism had proceeded beyond the first internode from the tip, and spore balls had replaced most of the parenchyma of the lower internode. Longitudinal sections through the diseased internodes revealed that spore balls were placed with the long axes parallel to the stem.

At maturity, when the spore balls have replaced all the parenchyma, they are released as a brown dust, and the vascular bundles, without any connecting tissue, remain to give the stem the ropy appearance.

GERMINATION.

One germ pore is located in the centre of the free side of each spore, and is most easily seen after the spore balls have been soaking for several days. Germination was obtained in water after three-six days. Up to five promycelia were noted from individual spore balls, each promycelium arising from a separate spore. Usually, however, one or two promycelia only were recorded from each spore ball. The promycelia were short (10-22 μ long and 2-4 μ wide), straight and three-septate. Young promycelia stained deeply with cotton-blue lacto-phenol. Thin branches were produced at the sides of the promycelia, either at or near the septa, and more rarely from the tip. Some branches arose at an acute angle, and as these hyphae elongated the promycelia became vacuolated. No development past this occurred in water, and no sporidia were detected. Spore balls dusted dry on to agar medium failed to germinate.

Sporidial production was induced, however, by presoaking spore balls in water until some spores had produced promycelia (about three days). The spore balls (both germinated and ungerminated) were then transferred to potato dextrose agar plates. Within twenty-four hours many promycelia were produced with abundant sporidia (Plate viii, D and E). No thin hyphal branches were produced at all. A colony developed around each spore ball by the production of chains of budding sporidia, in size 4-6 \times 1-2 μ . Germination on P.D.A. was fairly similar to that recorded by Kamat (1933) for *Tolyposporium filiferum* in sterile distilled water (his illustrations A, B, D in fig. 2).

Colonies were isolated and obtained in pure culture, being maintained on P.D.A. On this medium the colonies were dirty-white in colour, waxy and opaque. The edge was smooth and slightly lobed, with the centre of the colony becoming evenly convoluted by the masses of cells produced.

THE NUCLEAR CONDITION.

The promycelia and sporidia were stained with Giemsa after the method used by Knaysi et al. (1950) for bacteria, and which has been adapted for fungi (Shaw, unpublished).

One chromatinic body was observed in each cell of the promycelium (Text-fig 1, I) and in the sporidia. The nuclear condition of old and young cells produced on P.D.A. is shown in Plate viii, F, and Text-fig. 1, H.

NAME OF THE CAUSAL ORGANISM.

The production of a strongly septate promycelium with lateral and terminal sporidia, places the organism in the Ustilaginaceae, and as the spores are firmly united into balls, with the sori dusty and not agglutinated; *Thecaphora* and *Tolyposporium* appear to be the closest genera.

Germination in *Thecaphora*, however, is difficult to obtain (Barrus, 1944), and when it does occur is usually by a promycelium with a simple terminal sporidium (Clinton, 1902), although Woronin in 1882 (as cited by Ainsworth and Sampson, 1950) recorded the production of thin branches from a septate promycelium for *T. seminisconvoluti*. The sori of *Tolyposporium* are usually located in the inflorescence, and are usually darker than the sori of *Thecaphora*. The organism does not conform entirely to either genus, but the production of abundant lateral sporidia seems to indicate a closer affinity to *Tolyposporium* than to *Thecaphora*. Dr. Ellis, of the

Commonwealth Mycological Institute, Kew, who very kindly examined specimens, also agreed that this type of germination is in favour of the fungus being placed in *Tolyposporium* rather than in *Thecaphora*.

Because of the rope-like appearance of the diseased host, the name *Tolyposporium restifaciens* is proposed for the causal organism.

TOLYPOSPORIUM RESTIFACIENS, n. sp.

Sori between the lignified tissue of the internodes; spore balls dusty at maturity, brown (Sandford's Brown) to the naked eye, $18-40 \times 20-40 \mu$, composed of 5-26 spores permanently united; spores yellowish (Cadmium yellow) in reflected light, $8-10 \mu$ in diameter, subglobose to slightly angular, with adjacent and free sides smooth; promycelia with thin lateral and terminal branches in water, or with lateral and terminal sporidia on potato dextrose agar after presoaking in water.

Habitat.—In stems of *Stipa aristiglumis* F. Muell. and another unidentified grass.

Type.—S.U. Accession No. 693 collected at Breeza Plains, N.S.W., and held at University of Sydney. (Material also lodged at the C.M.I. as Herb. I.M.I. No. 47686.)

Distribution.—North-western slopes of New South Wales.

Tolyposporium restifaciens, sp. n.

Sporae in glomerulos arete coacervate pulverulentos cum maturi, $18-40 \times 20-40 \mu$, conflatos e 5-26 sporis perpetuo conjunctis; sporae fulvae, $8-10 \mu$, nunc subglobosae nunc subangulatae, adhaerenti et libero latere leves; promycelis in aqua ramis tenuibus a latere et a termino, in solido quodam lateralibus et terminalibus sporidiis praeditae.

Habitat.—In caulibus *Stipae aristiglumis* F. Muell.

Acknowledgements.

I gratefully acknowledge the assistance given by Professor W. L. Waterhouse, Dr. Ellis of the C.M.I. who examined specimens, Mr. J. J. Nicholls of the Latin Department for help with the Latin description, Miss J. Vickery of the Botanic Gardens who examined S.U. Acc. No. 535, and the various collectors who forwarded diseased material.

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EXPLANATION OF PLATE VIII.

- A. Ropy Smut (*Tolyposporium restifaciens*) on Liverpool Plains Grass (*Stipa aristiglumis*). $\times \frac{1}{2}$.
 B. Transverse section through green stem one inch from the tip, showing spore balls replacing the parenchyma. Stained with cotton-blue lacto-phenol. $\times 100$.
 C. Spore balls of *T. restifaciens*. $\times 200$.
 D. Germination of spore ball on P.D.A., with septate promycelia and budding sporidia, which are slightly displaced owing to staining with cotton-blue lacto-phenol. $\times 500$.
 E. Colony of budding sporidia developing around germination spore ball on P.D.A. Stained with cotton-blue lacto-phenol. $\times 250$.
 F. Budding sporidia from culture stained with Giemsa showing one nucleus per cell. $\times 1000$.
 G. Pure culture of *T. restifaciens* on P.D.A. $\times 1$.